

MODULE 3: MOVING ABOUT

NEWTON'S LAWS OF MOTION

PERIOD 1

27 JUNE 2009

WEEK 1 / TERM 3 - WEDNESDAY

The WORLD COMMUNICATES

ELECTRICAL ENERGY in the Home

MOVING ABOUT

COSMIC ENGINE

P R E L I M I N A R Y

P H Y S I C S

1

2

3

4

SPACE

1

2

3

4

5

MOTORS & GENERATORS

1

2

3

4

From IDEAS to IMPLEMENTATION

1

2

3

4

5

6

ASTROPHYSICS

H S C

P H Y S I C S

MOVING ABOUT 2

An analysis of the external forces on vehicles helps to understand the effects of acceleration and deceleration

Students learn to:

- describe the motion of one body relative to another
- identify the usefulness of using vector diagrams to assist solving problems
- explain the need for a net external force to act in order to change the velocity of an object
- describe the actions that must be taken for a vehicle to change direction, speed up and slow down
- describe the typical effects of external forces on bodies including:
 - friction between surfaces
 - air resistance
- define average acceleration as $a_{av} = \frac{\Delta v}{\Delta t}$ therefore $a_{av} = \frac{v - u}{t}$
- define the terms 'mass' and 'weight' with reference to the effects of gravity
- outline the forces involved in causing a change in the velocity of a vehicle when:
 - coasting with no pressure on the accelerator
 - pressing on the accelerator
 - pressing on the brakes
 - passing over an icy patch on the road
 - climbing and descending hills
 - following a curve in the road
- interpret Newton's Second Law of Motion and relate it to the equation $\Sigma F = ma$
- identify the net force in a wide variety of situations involving modes of transport and explain the consequences of the application of that net force in terms of Newton's Second Law of Motion

MOVING ABOUT 2

An analysis of the external forces on vehicles helps to understand the effects of acceleration and deceleration

Students:

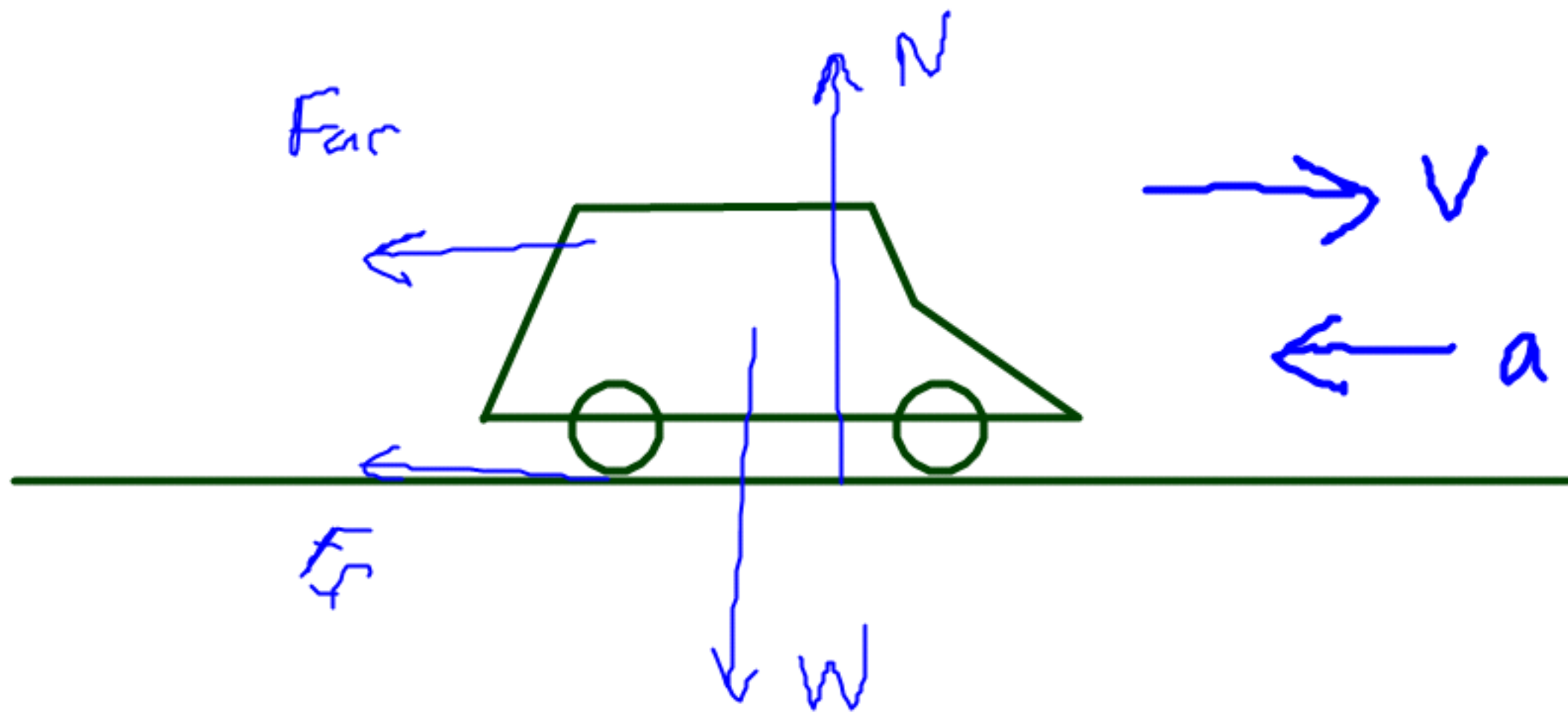
- analyse the effects of external forces operating on a vehicle
- gather first-hand information about different situations where acceleration is positive or negative
- plan, choose equipment or resources for and perform a first-hand investigation to demonstrate vector addition and subtraction
- solve problems using vector diagrams to determine resultant velocity, acceleration and force
- plan, choose equipment or resources for and perform first-hand investigations to gather data and use available evidence to show the relationship between force, mass and acceleration using suitable apparatus
- solve problems and analyse information using $\Sigma \mathbf{F} = m\mathbf{a}$ for a range of situations involving modes of transport
- solve problems and analyse information involving $F = \frac{mv^2}{r}$ for vehicles travelling around curves

outline the forces involved in causing a change in the velocity of a vehicle when:

- coasting with no pressure on the accelerator
- pressing on the accelerator
- pressing on the brakes
- passing over an icy patch on the road
- climbing and descending hills
- following a curve in the road

$$F_{\text{net}} = F_{\text{ar}} + F_{\text{f}}$$

slowing down



outline the forces involved in causing a change in the velocity of a vehicle when:

– coasting with no pressure on the accelerator

– pressing on the accelerator

– pressing on the brakes

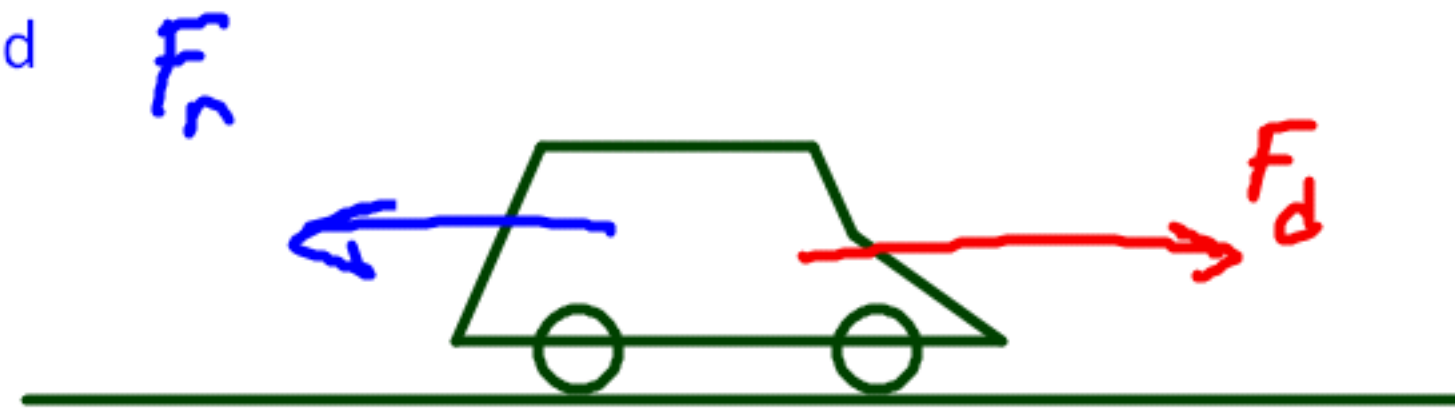
– passing over an icy patch on the road

– climbing and descending hills

– following a curve in the road

if $F_d > F_r$, speeding up

$\rightarrow a$
 $\rightarrow v$



if $F_d = F_r$, constant velocity $\rightarrow v$ $a = 0$

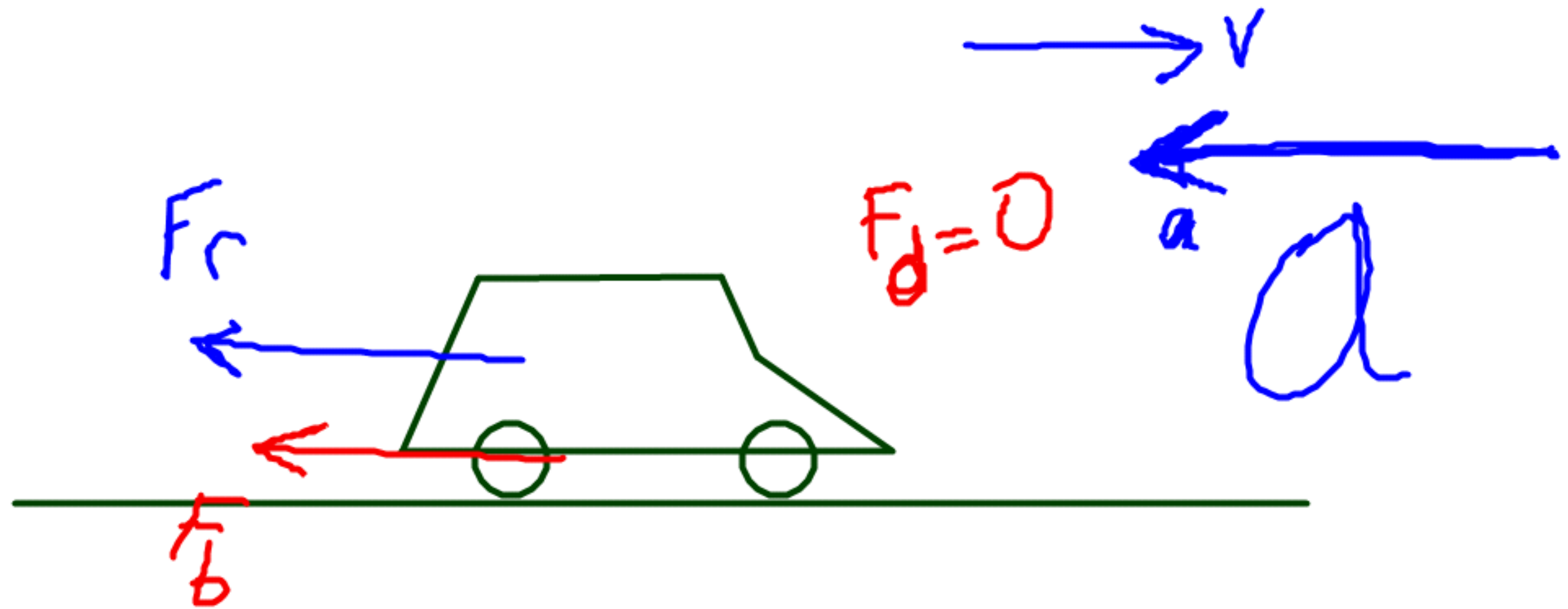
if $F_d < F_r$, slowing down $\rightarrow v$ $\leftarrow a$

$F_r = F_f + F_{ar}$
total resistive forces

outline the forces involved in causing a change in the velocity of a vehicle when:

- coasting with no pressure on the accelerator
- pressing on the accelerator
- pressing on the brakes
- passing over an icy patch on the road
- climbing and descending hills
- following a curve in the road

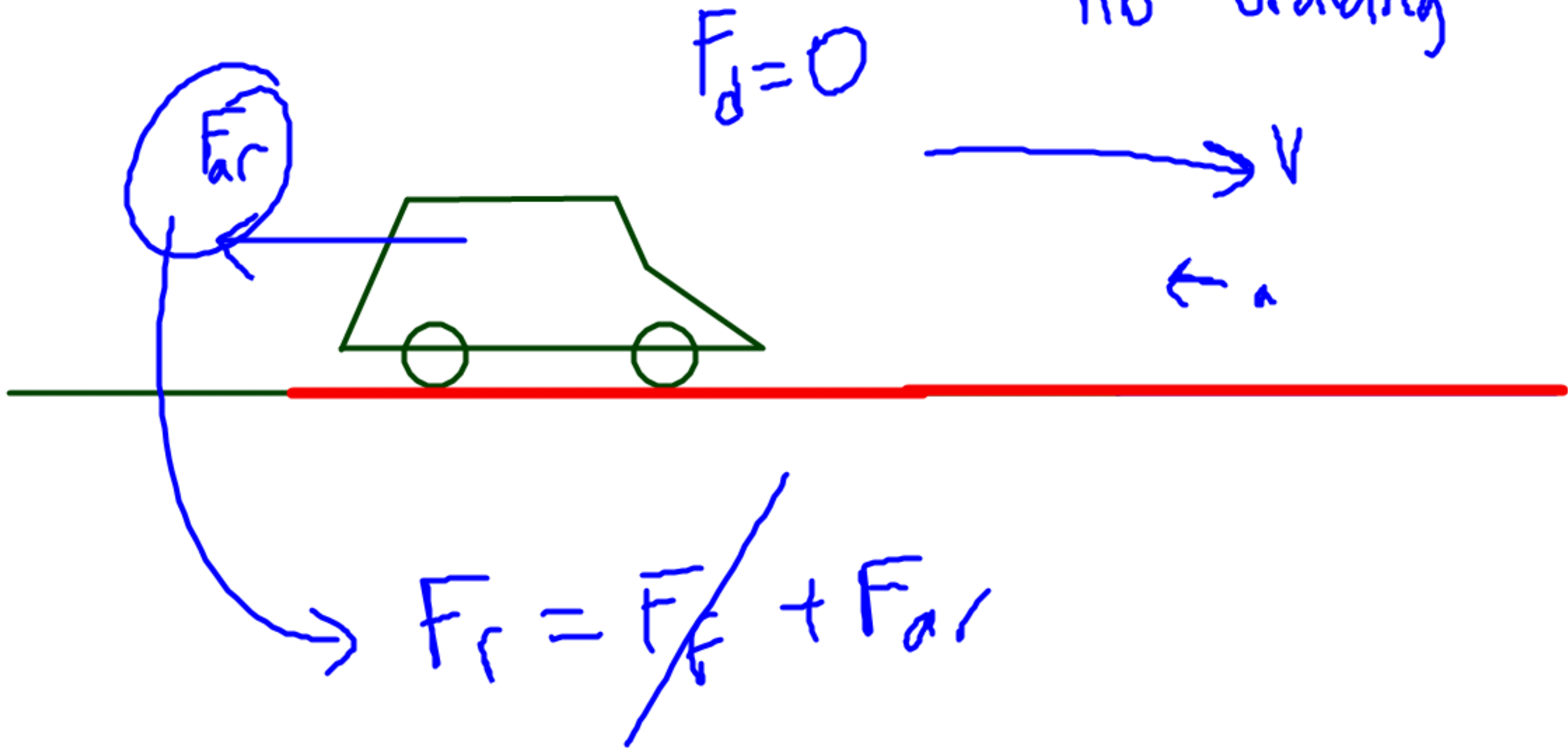
$$F_{\text{net}} = F_r + F_b$$



outline the forces involved in causing a change in the velocity of a vehicle when:

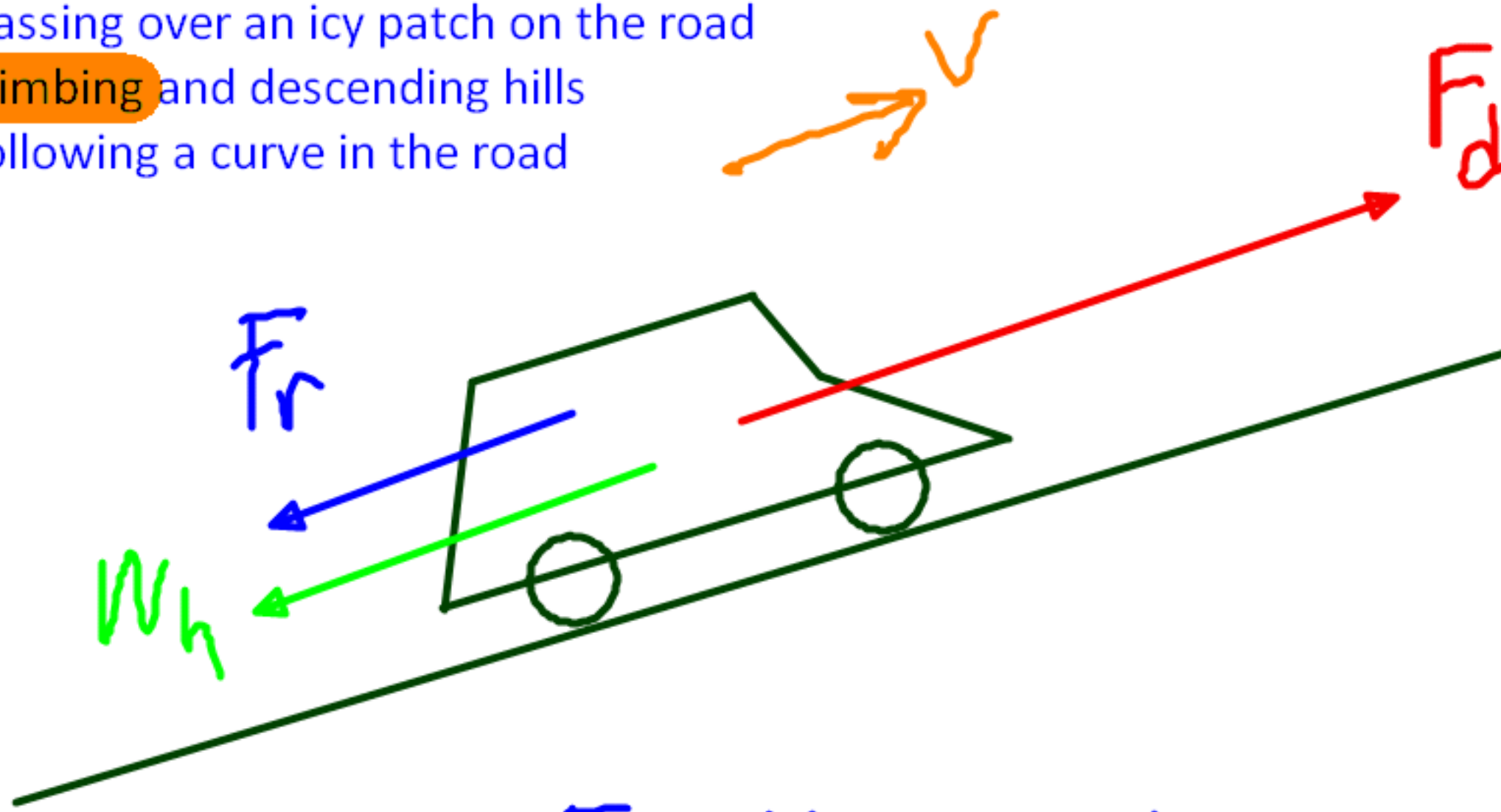
- coasting with no pressure on the accelerator
- pressing on the accelerator
- pressing on the brakes
- passing over an icy patch on the road
- climbing and descending hills
- following a curve in the road

no speeding
no steering
no braking



outline the forces involved in causing a change in the velocity of a vehicle when:

- coasting with no pressure on the accelerator
- pressing on the accelerator
- pressing on the brakes
- passing over an icy patch on the road
- climbing and descending hills
- following a curve in the road

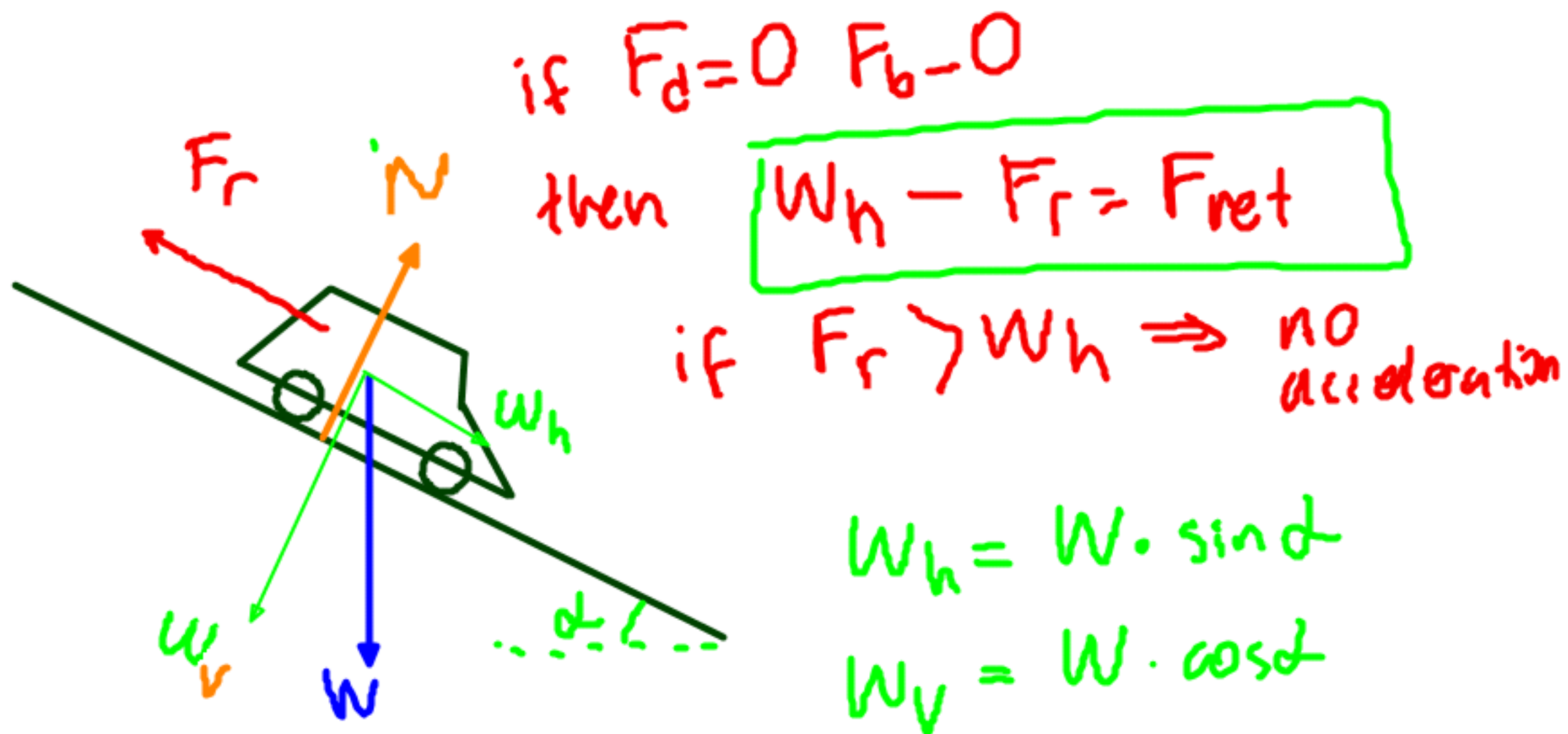


$$F_{\text{net}} = F_d - (W_h + F_r)$$

if $F_d = F_r + W_h \Rightarrow$ constant speed

if $F_d > F_r + W_h \Rightarrow \xrightarrow{v} \xrightarrow{a}$ speeding up.

if $F_d < F_r + W_h \Rightarrow \xrightarrow{v} \xleftarrow{a}$ slowing down



$N \neq W$ $N = W_v = W \cdot \cos \alpha$

if $F_d \checkmark$ $F_{ret} = (F_d + W_h) - F_r$

if $F_b \checkmark$ $F_{ret} = W_h - (F_r + F_b)$

$$F_c = F_{\text{centripetal}}$$

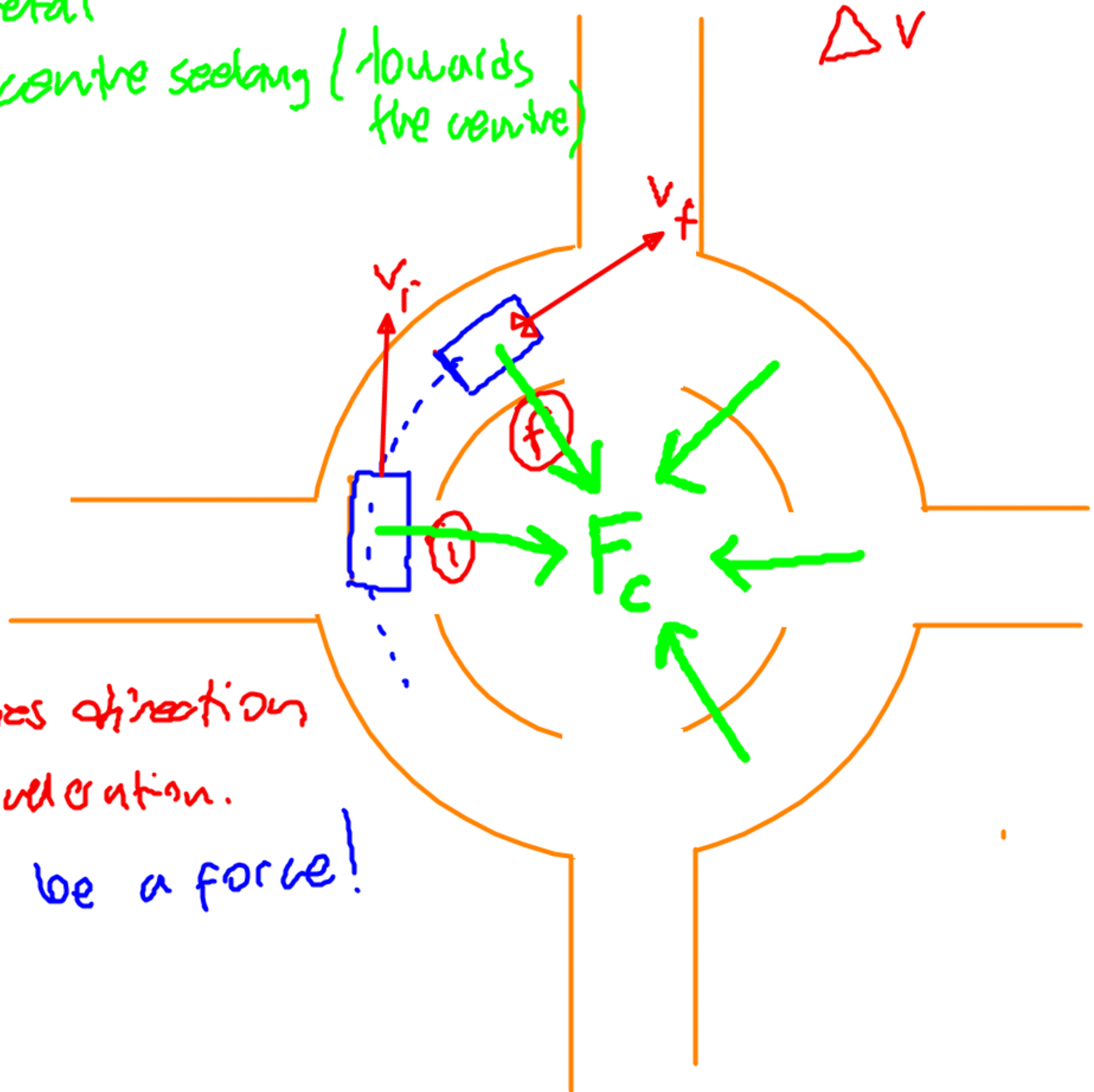
centripetal = centre seeking (towards the centre)

$$F_c = F_f$$

$$F_d = F_r$$

velocity changes direction
so there is acceleration.

so there must be a force!



HOMEWORK

- ✦ Homework is an integral part of your "Learning Curve", take it seriously!
- ✦ If you cannot do all, at least do a few from each piece
- ✦ Target minimum 1 hour of Physics everyday
- ✦ Homework is due next period, unless otherwise stated

Apart from reading the relevant pages from the textbook your homework is:

- 1. Study Chapter 10 up to page 211**
- 2. Holiday Worksheet first 15 questions**